

In the Claims:

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Q1 1. (Original) A magnetic sensing element comprising a laminate, the laminate including: a first antiferromagnetic layer; a pinned magnetic layer, a magnetization direction thereof being pinned by the first antiferromagnetic layer; a nonmagnetic conductive layer; a free magnetic layer, a magnetization direction thereof being variable in response to an external magnetic field; a nonmagnetic interlayer; a ferromagnetic layer; and a second antiferromagnetic layer, which magnetically couples with the ferromagnetic layer to orient a magnetization of the ferromagnetic layer in a predetermined direction,

wherein the laminate has a recess extending through the second antiferromagnetic layer and the ferromagnetic layer, a bottom face of the recess lying in the nonmagnetic interlayer, a width of the bottom face in a track width direction being equal to a track width; and

wherein the free magnetic layer is magnetized in a direction substantially orthogonal to the magnetization direction of the pinned magnetic layer as a result of magnetic coupling with the ferromagnetic layer.

2. (Original) The magnetic sensing element according to Claim 1, wherein the nonmagnetic interlayer comprises at least one metal selected from the group consisting of Ru, Rh, Ir, Cr, Re, and Cu.

3. (Original) The magnetic sensing element according to Claim 1, wherein at least one of the ferromagnetic layer and the free magnetic layer comprises a CoFeNi alloy containing about 9 to about 17 atomic percent of Fe, about 0.5 to about 10 atomic percent of Ni, and a balance of Co.

4. (Original) The magnetic sensing element according to Claim 1, wherein the laminate further includes an interlayer disposed between the free magnetic layer and the nonmagnetic conductive layer the interlayer comprising one of a CoFe alloy and elemental Co, the interlayer.

5. (Original) The magnetic sensing element according to Claim 4, wherein at least one of the ferromagnetic layer and the free magnetic layer comprises a CoFeNi alloy containing about 7 to about 15 atomic percent of Fe, about 5 to about 15 atomic percent of Ni, and a balance of Co.

6. (Original) The magnetic sensing element according to Claim 3, wherein both the ferromagnetic layer and the free magnetic layer comprise the CoFeNi alloy.

7. (Original) The magnetic sensing element according to Claim 1, wherein side faces of the recess are perpendicular to the track width direction.

8. (Original) The magnetic sensing element according to Claim 1, the laminate further comprising a nonmagnetic layer disposed between the ferromagnetic layer and the second antiferromagnetic layer.

9. (Original) The magnetic sensing element according to Claim 8, wherein the nonmagnetic layer comprises at least one element selected from the group consisting of Ru, Cu, Ag, and Au.

10. (Original) The magnetic sensing element according to Claim 9, wherein the

nonmagnetic layer comprises Ru and has a thickness in the range of about 8 to about 11 Å.

11. (Original) The magnetic sensing element according to Claim 1, the laminate further comprising a third antiferromagnetic layer disposed under the second antiferromagnetic layer.

12. (Original) The magnetic sensing element according to Claim 11, wherein the third antiferromagnetic layer has a thickness of not more than about 30 Å.

13. (Original) The magnetic sensing element according to Claim 1, wherein the pinned magnetic layer comprises: a plurality of ferromagnetic sublayers each differing in a magnitude of a magnetic moment per unit area, and at least one nonmagnetic intermediate sublayer separating the plurality of ferromagnetic sublayers from one another, and

wherein magnetization directions of the plurality of ferromagnetic sublayers are antiparallel to each other.

14. (Original) The magnetic sensing element according to Claim 13, wherein said at least one nonmagnetic intermediate sublayer comprises one metal selected from the group consisting of Ru, Rh, Ir, Cr, Re, and Cu.

15. (Original) The magnetic sensing element according to Claim 1, wherein the first antiferromagnetic layer and the second antiferromagnetic layer comprise the same antiferromagnetic material.

16. (Original) The magnetic sensing element according to Claim 1, wherein at least one of the first and second antiferromagnetic layers comprises one of a PtMn alloy, an X-Mn alloy, and a Pt-Mn-X' alloy, wherein X is at least one element selected from the group consisting of Pd, Ir, Rh, Ru, Os, Ni, and Fe, and X' is at least one element selected from the group consisting of Pd, Ir, Rh, Ru, Au, Ag, Os, Cr, Ni, Ar, Ne, Xe, and Kr.

17.-46. (Cancelled)

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